

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE**NUMBER: 05-6-2490 -X****SUBSYSTEM NAME:** ELECTRICAL POWER DISTRIBUTION & CONTROL**REVISION:** 1 11/12/01

PART DATA

PART NAME	PART NUMBER
VENDOR NAME	VENDOR NUMBER
LRU : MEC 1 AND 2	MC450-0016-0006 11901-507-71
LRU : MEC 1 AND 2	MC450-0016-0008

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

MASTER EVENTS CONTROLLER (MEC) CRITICAL OUTPUTS, MODULE IV - CORE A AND B
PIC INPUTS (ARM, FIRE 1, FIRE 2 COMMANDS)

REFERENCE DESIGNATORS: 54V76A13
55V76A14

QUANTITY OF LIKE ITEMS: 2

TWO MECS PER VEHICLE AND TWO CORES (A AND B) PER MEC

FUNCTION:

EACH MASTER EVENTS CONTROLLER CORE A OR B PROVIDES REQUIRED SIGNAL OUTPUT TO SUPPLY INDIVIDUAL PYROTECHNIC INITIATOR CONTROLLER (PIC) INPUTS (ARM, FIRE 1 AND FIRE 2) FOR ALL PYRO FUNCTIONS ASSOCIATED WITH SRB IGNITION, SEPARATION AND EXTERNAL TANK/ORBITER SEPARATION. ADDITIONALLY, MEC'S 1 AND 2 ARE PROGRAMMED TO RETRACT ORB/ET UMBILICALS FOR LH2/LOX AFTER MAIN ENGINE CUTOFF. EACH MEC PROVIDES REDUNDANT POWER TO THE RETRACT INDIVIDUALLY THE LH2 AND THE LOX UMBILICALS - ORB/ET LH2 UMBILICAL HYDRAULIC ACTUATORS 1, 2, AND 3, ORB/ET LOX UMBILICAL HYDRAULIC ACTUATORS 1, 2, AND 3. (REFERENCE ASSOCIATED MEC/PIC CILS: 05-6-2509-01, 05-6-2509-02, 05-6-2510-01 AND 05-6-2510-02)

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE

NUMBER: 05-6-2490- 01

REVISION#: 3 01/17/02

SUBSYSTEM NAME: ELECTRICAL POWER DISTRIBUTION & CONTROL

LRU: MEC 1 AND 2

CRITICALITY OF THIS

ITEM NAME: MEC 1 AND 2

FAILURE MODE: 1R2

FAILURE MODE:

LOSS OF CRITICAL OUTPUT (ARM, FIRE 1 AND FIRE 2 COMMANDS)

MISSION PHASE:

PL PRE-LAUNCH
LO LIFT-OFF

VEHICLE/PAYLOAD/KIT EFFECTIVITY:

102 COLUMBIA
103 DISCOVERY
104 ATLANTIS
105 ENDEAVOUR

CAUSE:

PIECE PART FAILURE, CONTAMINATION, VIBRATION, MECHANICAL SHOCK, PROCESSING ANOMALY, THERMAL STRESS

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN

- A) PASS
- B) FAIL
- C) PASS

PASS/FAIL RATIONALE:

A)

B)

FAILS "B" SCREEN BECAUSE NO INSTRUMENTATION EXISTS TO MONITOR REDUNDANT CORE OUTPUT COMMANDS DURING FLIGHT.

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

DEGRADATION OF REDUNDANCY FOR PROVIDING CRITICAL OUTPUTS. REDUNDANT CORE AND REDUNDANT MEC PROVIDE FUNCTIONS.

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SAME AS (A).

(C) MISSION:

FIRST FAILURE - NO EFFECT

(D) CREW, VEHICLE, AND ELEMENT(S):

FIRST FAILURE - NO EFFECT

(E) FUNCTIONAL CRITICALITY EFFECTS:

POSSIBLE LOSS OF CREW/VEHICLE AFTER TWO FAILURES:

- (1) LOSS OF SIGNAL RETURN TO GROUND CAUSED BY FAIL OPEN OF INDUCTOR, WILL RESULT IN LOSS OF CRITICAL COMMANDS FROM BOTH REDUNDANT MEC CORES TO ASSOCIATED PIC AND LOSS OF THAT PIC.
- (2) FAILURE OF REDUNDANT PIC WILL RESULT IN LOSS OF ABILITY TO PERFORM CRITICAL FUNCTION SUCH AS: SRB IGNITION, SRB SEPARATION, OR PERFORM EXTERNAL TANK SEPARATION

ALSO POTENTIAL LOSS OF CREW/VEHICLE AFTER THREE FAILURES

- (1) LOSS OF ONE MEC CORE OUTPUT TO A PIC COMMAND
- (2) LOSS OF THE SECOND MEC CORE OUTPUT TO THE SAME PIC COMMAND,
- (3) FAILURE OF REDUNDANT PIC RESULTING IN LOSS OF ABILITY TO PERFORM CRITICAL FUNCTION SUCH AS: SRB IGNITION, SRB SEPARATION, OR PERFORM EXTERNAL TANK SEPARATION

ALSO POTENTIAL LOSS OF CREW/VEHICLE AFTER FOUR FAILURES

- (1) LOSS OF ONE MEC CORE OUTPUT TO A PIC COMMAND
- (2) LOSS OF REDUNDANT CORE OUTPUT TO THE SAME PIC COMMAND
- (3,4) LOSS OF CRITICAL PIC COMMANDS FROM BOTH CORES IN THE REDUNDANT MEC RESULTING IN LOSS OF ABILITY TO PERFORM CRITICAL FUNCTION SUCH AS: SRB IGNITION, SRB SEPARATION, OR PERFORM EXTERNAL TANK SEPARATION

ALSO, POTENTIAL LOSS OF CREW/VEHICLE AFTER FIVE FAILURES ASSOCIATED WITH THE ORBITER TO ET UMBILICAL PLATE.

- (1,2) FIRST TWO FAILURES - LOSS OF BOTH MEC CORE FUNCTIONS TO COMMAND TWO HYDRAULIC ET UMBILICAL ACTUATORS ON THE SAME UMBILICAL PLATE
- (3,4) LOSS OF REDUNDANT MEC CORE FUNCTIONS TO COMMAND THE SAME TWO HYDRAULIC ACTUATORS
- (5) FAILURE OF PNEUMATIC VALVE CLOSURE FUNCTION ON 17 INCH QUICK DISCONNECT RESULTING IN: THE MAXIMUM ALLOWABLE CERTIFIED PLATE RETRACT VELOCITY OF 1.1 IN/SEC COULD BE EXCEEDED WITH POSSIBLE

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DAMAGE TO THE VALVE CLOSURE LINKAGE. DAMAGE TO THE VALVE CLOSURE LINKAGE COULD (1) INTERFERE WITH FULL ET 17 INCH QUICK DISCONNECT CLOSURE AND RESULT IN POSSIBLE RECONTACT BETWEEN THE EXTERNAL TANK AND THE ORBITER (CRITICALITY 1 - NO ET QD CLOSURE TELEMETRY EXISTS); OR (2) INTERFERE WITH ET UMBILICAL DOOR CLOSURE AND RESULT IN CRITICAL HEATING DURING REENTRY (CRITICALITY(1)).

-DISPOSITION RATIONALE-

(A) DESIGN:

FUNCTIONAL DESCRIPTION

THE MASTER EVENTS CONTROLLER CONSISTS OF AN INTERFACE WHICH RECEIVES COMMANDS FROM THE GENERAL PURPOSE COMPUTERS (GPC'S) VIA SEPARATE MULTIPLE INTERFACE ADAPTERS (MIA'S) AND WHICH TRANSMITS TEST AND MEASUREMENT DATA ON ONE CHANNEL TO ONE OF THE GPC'S. VALID COMMANDS ARE DECODED AND USED TO ENABLE THE REQUIRED PYRO INITIATOR CONTROLLER (PIC) INPUT COMMANDS. THERE ARE A MAXIMUM OF 57 CRITICAL COMMAND DATA WORDS AND ASSOCIATED DRIVERS TO THE INTERNAL AND REMOTE PIC'S. THE ELECTRICAL, ELECTRONIC AND ELECTROMECHANICAL COMPONENTS ARE SELECTED FROM OR IN ACCORDANCE WITH THE ORBITER PREFERRED PARTS LIST (OPPL) REQUIREMENTS. COMPONENT APPLICATIONS ARE EVALUATED TO ASSURE COMPLIANCE WITH DERATING REQUIREMENTS.

PHYSICAL DESCRIPTION

THE DESIGN INCORPORATES RELIABILITY, MAINTAINABILITY, ENVIRONMENTAL AND TRANSPORTABILITY REQUIREMENTS AND OTHER DESIGN AND CONSTRUCTION PER SPECIFICATION MC450-0016.

THE CERTIFIED PART NUMBERS ARE MC450-0016-0006 AND MC450-0016-0008. DASH NUMBERS -0001 THROUGH -0005 ARE INACTIVE.

DESIGN EVOLUTION

THE -0001 CONFIGURATION WAS INITIALLY BUILT FOR OV-102.

THE -0002 CONFIGURATION WAS INITIALLY BUILT FOR OV-99 AND CONTAINED AN UPGRADED MIA (MC615-0040-0004).

THE -0003 CONFIGURATION (INITIALLY BUILT FOR OV-103) WAS NEVER RELEASED FROM MANUFACTURING AND WAS REPLACED BY THE -0004 CONFIGURATION.

THE -0004 CONFIGURATION INCORPORATED A NUMBER OF CHANGES TO PRECLUDE INTERACTION BETWEEN INACTIVE DATA REGISTERS AND ACTIVE DATA REGISTERS CREATED BY TIME SKEW CONDITIONS. THIS PREVENTS SPURIOUS SIGNALS ON NON-CRITICAL OUTPUTS WITH NORMAL SYSTEM SKEWING. ADDITIONAL CIRCUIT CHANGES

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WERE IMPLEMENTED TO PRECLUDE INADVERTENT FIRING OF PIC CIRCUITS AND TO TOLERATE PREMATURE FIRE 2 COMMAND FAILURES. ANOTHER CHANGE WAS TO DELETE PIC'S 9 AND 10.

THE -0005 CONFIGURATION MODIFICATION CONSISTED OF ADDING BLEED RESISTORS ACROSS THE FIRE 2 PULSE TRANSFORMER OUTPUT CAPACITORS. THIS MODIFICATION INSURED THE PROPER MEC OUTPUTS TO PYRO DEVICES IN THE CASE OF AN INCOMPLETE FIRST FIRE 2/3 MESSAGE TO THE MEC FROM THE GPC.

THE -0006 CONFIGURATION INCORPORATED A SHIM MODIFICATION TO ELIMINATE A MODULE BOARD STRESS PROBLEM THAT CAUSED CRACKED SOLDER JOINTS IN SOME OF THE MODULE BOARD COMPONENTS.

THE -0008 CONFIGURATION INCORPORATES A MODIFICATION TO THE BOTTOM COVER TO PREVENT POTENTIAL INTERFERENCE WITH COMPONENTS.

(B) TEST:

QUALIFICATION/CERTIFICATION

CERTIFICATION TESTING AND ANALYSIS ARE COMPLETED AND APPROVED. QUALIFICATION TESTING (QUAL TEST REPORT C79-738/201) INCLUDING FULL FUNCTIONAL, THERMAL, VIBRATION, SHOCK, POWER, ELECTROMAGNETIC COMPATIBILITY (EMC), THERMAL VACUUM, AND LIFE HAS BEEN PERFORMED.

ACCEPTANCE AND SCREENING

EACH UNIT IS SUBJECTED TO ACCEPTANCE TEST PROCEDURE (ML0101-0105) AT THE REPAIR CENTER INCLUDING VISUAL EXAMINATION, FULL FUNCTIONAL, ACCEPTANCE THERMAL TEST (ATT) AND ACCEPTANCE VIBRATION TEST (AVT).

GROUND TURNAROUND TEST

ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

RECEIVING INSPECTION

RECEIVING INSPECTION VERIFIES ALL INCOMING PARTS AND MATERIALS, INCLUDING PERFORMANCE OF VISUAL AND DIMENSIONAL EXAMINATIONS, IN ACCORDANCE WITH REQUIREMENTS. CERTIFICATION RECORDS AND TEST REPORTS ARE MAINTAINED CERTIFYING MATERIALS AND PHYSICAL PROPERTIES.

CONTAMINATION CONTROL

A CONTROLLED WORK AREA IS UTILIZED FOR ASSEMBLY AND TEST. QUALITY CONTROL (QC) VERIFIES PROPER MAINTENANCE OF CLEANLINESS CONTROL.

ASSEMBLY/INSTALLATION

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INSPECTION POINTS ARE DETERMINED BY QUALITY ENGINEERING IN ACCORDANCE WITH APPLICABLE REQUIREMENTS AND ARE DOCUMENTED ON INSPECTION PLANNING. WORK STATION DISCIPLINES ADHERED TO AND OBSERVED MORE THAN FIVE TIMES PER WEEK BY QC.

CRITICAL PROCESSES

ALL CRITICAL PROCESSES AND CERTIFICATIONS ARE MONITORED AND VERIFIED BY QC AS PROCESS CONTROL SURVEILLANCE ACTIVITY (OPERATIONS AUDIT). THE CRITICAL PROCESSES ARE SOLDERING, BONDING OF COMPONENTS FOR MECHANICAL STABILITY/THERMAL CONDUCTIVITY, COMPONENT PLACEMENT, WIRE ROUTING, AND CRIMPING. FORMAL CERTIFICATION FOR SOLDERING AND QUALIFICATION FOR CRIMPING ARE MAINTAINED.

TESTING

ACCEPTANCE TESTS, INCLUDING VIBRATION, THERMAL AND INSULATION RESISTANCE (IR), ARE OBSERVED AND VERIFIED BY QC.

HANDLING/PACKAGING

HANDLING OF CMOS/MOS DEVICES TO PRECLUDE ELECTROSTATIC DISCHARGE (ESD) VERIFIED BY QC. PARTS PACKAGED AND PROTECTED ARE VERIFIED BY INSPECTION TO APPLICABLE REQUIREMENTS.

(D) FAILURE HISTORY:

CURRENT DATA ON TEST FAILURES, FLIGHT FAILURES, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATA BASE. THE FAILURE HISTORY DATA IN THE PRACA DATABASE IS NO LONGER BEING KEPT UP-TO-DATE.

(E) OPERATIONAL USE:

NONE

- APPROVALS -

SAFETY ENGRG	: T. AI/K. RYAN	:/S/ K. E. RYAN_____
SAFETY ENGRG ITM	: P. A. STENGER_NGUYEN	:/S/ P. A. STENGER-NGUYEN_
MEC/AMEC/EMEC SSM	: P. VU	:/S/ PHAT VU__11/15/01_____
EPD&C SSM	: L. MINTER	:/S/ LARRY MINTER_1/11/02____
MOD	:	:/S/ JEFFREY MUSLER_1/11/02____
USA SAM	:	:/S/ PAUL KRAUSE_1/15/02_____
USA ORBITER ELEMENT	: S. LITTLE	:/S/ JAMES WILDER FOR1/11/02_____